

Role of Color Doppler Ultrasonography in Evaluation of Scrotal Swellings

Pattern of Disease in 120 Patients With Review of Literature

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Purpose: To determine the value of color Doppler ultrasonography (CDUS) as a routine investigational method for diagnosis of scrotal pathologies.

Materials and Methods: This prospective observational study (case series) was carried out over a period of 16 months on 122 patients in the age range of 13 to 70 years old, who presented with scrotal swellings. After adequate history taking and examination, CDUS was performed. The diagnosis of the surgeon and that of radiologist were compared with final outcome, which was based on course and outcome of the disease, fine needle aspiration cytology results, and operative findings.

Results: The final diagnoses were epididymitis or epididymo-orchitis (46), hydrocele (26), varicocele (16), testicular malignancy (16), orchitis (6), testicular torsion (4), spermatic cord injury (2), hematocele (2), and pyocele (2). Color Doppler ultrasonography accurately diagnosed all cases of epididymitis or epididymo-orchitis, spermatic cord injury, testicular torsion, varicocele, and hydrocele (sensitivity 100% and specificity 100%). Of 16 subjects diagnosed as testicular malignancy on CDUS, only 14 were subsequently found to have malignancy. Two cases of orchitis were wrongly diagnosed as malignancy. Similarly, of 6 patients diagnosed as orchitis, 1 was found to have seminoma (sensitivity 87.5% and specificity 66.7%). Overall sensitivity of CDUS in diagnosing scrotal diseases was 98% while specificity was 66.7%.

Conclusion: Color Doppler ultrasonography is an excellent, a safe, and reliable method for evaluating patients with scrotal diseases. It aids in diagnosis of testicular tumors and reduces the number of unnecessary exploratory operations. It is especially important in conditions like testicular torsion where immediate diagnosis is required.

Keywords: scrotum, color doppler ultrasonography, retrospective studies

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INTRODUCTION

Color Doppler ultrasonography (CDUS) is an important tool for diagnosis of scrotal diseases because of its ability to depict anatomy and perfusion in real time.⁽¹⁾ Diagnosis of scrotal diseases has always been a challenge for the clinician due to non-specific signs and symptoms.⁽²⁾

The causes of scrotal swelling can be classified as acute and non-acute. Acute causes include torsion, trauma, abscess, and orchitis. Non-acute causes include hydrocele, scrotal hernia, lymphocele, and others. Scrotal lesions can also be classified as testicular and extratesticular. The common

testicular lesions are torsion, trauma, neoplasms, and inflammatory conditions. Extratesticular lesions include lesions of the spermatic cord, the epididymis, and the scrotal wall. This distinction is important because extratesticular masses are almost always benign while intratesticular solid masses may be malignant. Ultrasonography plays a major role in distinguishing intratesticular from extratesticular abnormalities.

MATERIALS AND METHODS

This prospective observational study (case series) was conducted in the Jawaharlal Nehru Medical College Hospital (JNMCH), AMU Aligarh over a span of 16 months from September 2008 to January 2010. The study was approved by the ethical committee of the hospital and a written informed consent was taken from each patient.

Inguinoscrotal hernia and undescended testis were the exclusion criteria. A total of 122 patients in the age range of 13 to 70 years old, with scrotal pathologies were included in the study. Two subjects were lost in the follow-up period.

After adequate history taking and physical examination, CDUS was performed. The patients were scanned with the linear color Doppler multi-frequency (7 to 9 MHz) transducer using LOGIQ 500 (GE Wipro) ultrasound machine and sagittal and transverse images were obtained. Additional views were also obtained in coronal and oblique planes, with the patient being upright

and performing Valsalva maneuver.

Diagnostic accuracy of CDUS was determined by comparing it with the final diagnosis, which was based on clinical outcome (ie, positive response to medical treatment), operative findings, fine needle aspiration cytology (FNAC), and histopathological examination results.

RESULTS

The majority of the patients with acute scrotal condition were in their 2nd and 3rd decades of life whereas those presenting with testicular masses were in their 5th and 6th decades.

With the help of CDUS, the diagnoses of epididymitis and epididymo-orchitis were made in 46 out of 52 patients who presented with clinical suspicion (Figure 1). All of these 46 patients were conservatively managed and follow-up CDUS revealed resolution of findings.

All patients with symptoms of varicocele were in their 2nd and 3rd decades of life. Of 14 patients, 10 were clinically diagnosed with unilateral and 4 with bilateral varicoceles. These patients were subjected to CDUS, which showed multiple serpiginous anechoic structures adjacent to upper pole of the testis and head of the epididymis with venous flow that accentuated on performing Valsalva maneuver or making the patient upright (Figure 2). Doppler ultrasonography confirmed the presence of unilateral varicocele in 8 patients,

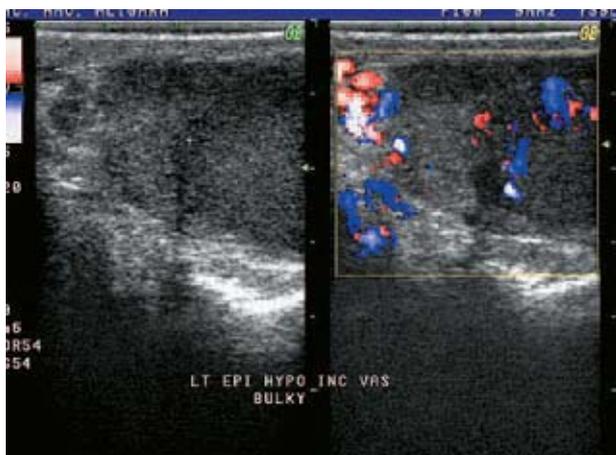


Figure 1. Epididymitis. Longitudinal ultrasonographic image of the right testis demonstrates enlarged, thickened, and heterogeneous epididymis. Doppler ultrasonography shows an increase in vascular flow.

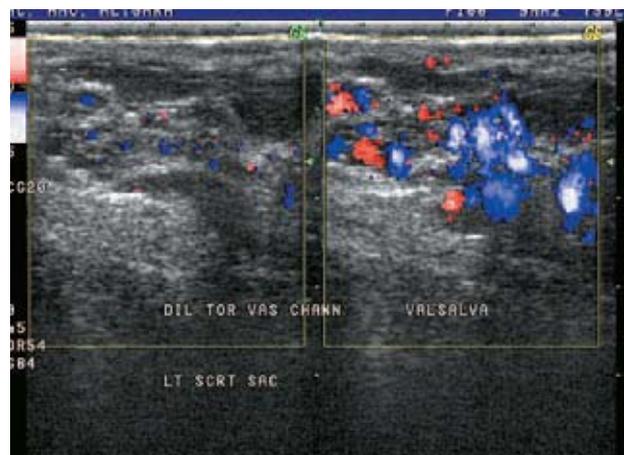


Figure 2. Varicocele. Color Doppler ultrasonography demonstrates multiple serpentine vascular channels within the scrotum, which become more prominent after Valsalva maneuver.

but detected bilateral varicocele in 2 subjects that were clinically diagnosed as unilateral varicocele. It also confirmed bilaterality of varicocele in 4 patients. Further, 2 patients who presented with infertility and had normal scrotum clinically were diagnosed as case of varicocele on CDUS.

Twenty-six patients with clinical suspicion of hydrocele were also subjected to CDUS, which supported the diagnosis. Color Doppler ultrasonography also found hydrocele in 4 clinically unsuspected subjects. On aspiration, only 26 were found to have hydrocele while hematocele and pyocele were found in 2 others.

Four patients were clinically diagnosed as cases of testicular torsion. Color Doppler ultrasonography showed absent intratesticular blood flow confirming the diagnosis. Surgery was done, which supported the diagnosis.

Two patients who presented with history of trauma to the scrotum were also diagnosed as a case of traumatic spermatic cord injury. The patients were managed with antibiotics, and follow-up examination showed complete resolution of inflammatory changes in all the patients. Fine needle aspiration cytology was not required.

Therefore, we found that CDUS was 100% sensitive and 100% specific for diagnosing scrotal diseases other than testicular masses (Tables 1 and 2).

Twenty-two patients who presented with

Table 2. Sensitivity and specificity of color Doppler ultrasonography in diagnosis of scrotal diseases other than testicular masses

Doppler Diagnosis	Final outcome		Total
	Disease present	Disease absent	
Disease present	98	0	98
Disease absent	0	0	0
	98	0	98

*Sensitivity: $98 / 98 + 0 \times 100 = 100\%$
 Specificity: $0 / 0 + 0 \times 100 = 100\%$

enlargement of the scrotum were clinically labeled as cases of testicular mass. The size of the lesion ranged from 1.1 cm to 5.5 cm. They were subjected to CDUS, which showed localized involvement in 36.6% and diffuse involvement in 63.4%. Increased vascularity was revealed in all the subjects, and diagnoses of testicular mass and orchitis were made in 16 and 6 patients, respectively. Subsequently, all 16 subjects with diagnosis of testicular mass were subjected to FNAC. Fourteen out of 16 patients turned out to be seminoma (Figure 3) while 2 misdiagnosed subjects turned out to be orchitis. Six out of 22 clinically diagnosed cases of testicular mass were labeled as orchitis on CDUS (Figure 4). However, FNAC results showed one of them to be seminoma. Color Doppler ultrasonography was 87.5% sensitive and 66.7% specific in diagnosing testicular masses (Tables 1 and 3). In all confirmed cases of seminoma, orchidectomy was performed and FNAC diagnoses were comparable to final histopathological examination.

Overall sensitivity of CDUS in the diagnosis of

Table 1. The clinical diagnosis, CDUS diagnosis, and final outcome*

Lesion	Clinical Diagnosis	CDUS Diagnosis	Intervention	Final Outcome
1 Epididymitis/ Epididymo-orchitis	52	46	Antibiotics	Epididymitis/ Epididymo-orchitis 46
2 Spermatic cord injury	2	2	Antibiotics	Spermatic cord injury 2
3 Testicular torsion	4	4	Surgery	Testicular torsion 4
4 Testicular mass	22	Testicular mass – 16	FNAC	Seminoma – 14 Orchitis – 2
		Orchitis - 6	FNAC	Orchitis – 4 Seminoma – 2
5 Varicocele	14	16	---	Varicocele – 16
6 Hydrocele	26	30	Aspiration	Hydrocele – 26 Hematocele – 2 Pyocele – 2

*CDUS indicates color Doppler ultrasonography; and FNAC, fine needle aspiration cytology.

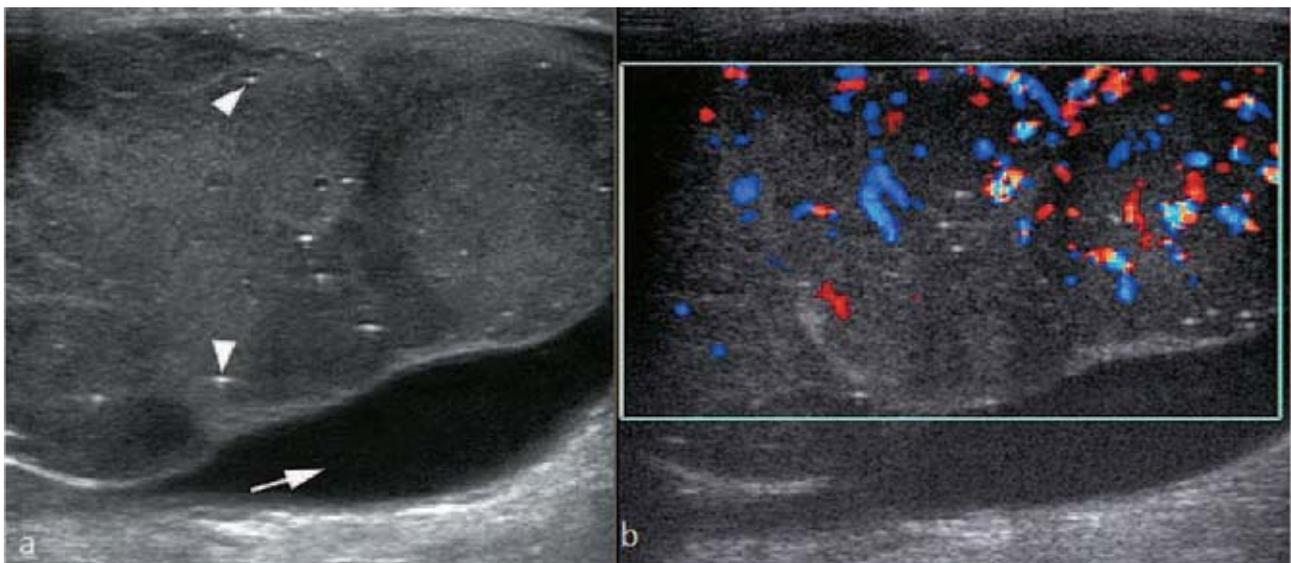


Figure 3. Seminoma. (a) Longitudinal ultrasonographic image of the right testis demonstrates a diffuse homogeneous mass with scattered microlithiasis and associated hydrocele. (b) Doppler ultrasonographic image shows a generalized increase in testicular vascular flow.



Figure 4. Orchitis. Color Doppler ultrasonography of the scrotum reveals hypoechoic left testis with markedly increased vascularity, compared with normal echogenic right testis showing normal vascularity.

Table 3. Sensitivity and specificity of color Doppler ultrasonography in diagnosis of testicular masses

Doppler Diagnosis	FNAC diagnosis*		Total
	Positive	Negative	
Tumor	14	2	16
Non tumor	2	4	6
	16	6	22

*FNAC indicates fine needle aspiration cytology.

†Sensitivity: $14/14 + 2 \times 100 = 87.5\%$

Specificity: $4/4 + 2 \times 100 = 66.7\%$

Table 4. Overall sensitivity and specificity of color Doppler ultrasonography in diagnosis of scrotal diseases

Doppler Diagnosis	Final outcome		Total
	Disease present	Disease absent	
Disease present	112	2	114
Disease absent	2	4	6
	114	6	120

*Sensitivity: $112/112 + 2 \times 100 = 98.0\%$

Specificity: $4/4 + 2 \times 100 = 66.7\%$

scrotal diseases was 98% while specificity was 66.7% (Table 4).

DISCUSSION

Grey scale ultrasonography is a well-established modality for diagnosis of scrotal diseases; however, the major limitation of conventional grey scale ultrasonography is lack of specificity for parenchymal changes. Also benign and malignant lesions cannot be distinguished on the basis of ultrasonography alone.⁽³⁾ Furthermore, in painful scrotum, grey scale ultrasonography cannot accurately differentiate testicular torsion from epididymo-orchitis. William and colleagues studied 5 patients in whom no intratesticular blood flow was identified on symptomatic side while normal flow was detected on the opposite side. However, on grey scale ultrasonography, no abnormality could be detected in 3 patients while 2 subjects had non-specific findings.⁽⁴⁾

Color Doppler ultrasonography has many advantages over conventional ultrasonography. In addition to detecting non-specific grey scale changes that can occur with testicular ischemia, it also shows blood flow in testicular arteries. Till recently, radionuclide scanning has played an important role in evaluation of equivocal cases of acute scrotal diseases. It has provided useful information regarding scrotal blood flow.⁽⁵⁾ However, it cannot accurately depict the anatomy.⁽⁶⁾

Middleton and associates evaluated 28 patients with acute scrotal pain by CDUS and scintigraphy. While CDUS correctly diagnosed all the subjects, scintigraphy failed to reach the diagnosis in one.⁽⁷⁾ Also CDUS was more rapid, non-invasive, and at least as accurate as scintigraphy.⁽⁸⁾

Accurate clinical diagnoses of scrotal diseases are difficult as most patients present with similar signs and symptoms.⁽²⁾ Color Doppler ultrasonography is currently the most important imaging modality available for diagnosis of scrotal pathologies. It allows accurate evaluation of scrotal conditions as well as normal anatomy.

Becker and coworkers concluded a sensitivity of 90.5% and specificity of 98.3% in diagnosis of

testicular torsion.⁽⁹⁾ Süzer and colleagues found CDUS to be 100% sensitive and 100% specific in diagnosis of acute scrotal conditions.⁽¹⁰⁾

In our study, of 26 patients who had acute presentation, 23 were diagnosed with epididymitis or epididymo-orchitis. In all the patients, the epididymis was enlarged, hypoechoic, and hyperemic. In 5 patients, in addition to the epididymis, the testis was also hypoechoic and hyperemic. Two patients were diagnosed as cases of testicular torsion. Both patients showed mild enlargement, hypoechoic echotexture, and markedly decreased vascularity. Color Doppler ultrasonography showed sensitivity and specificity of 100%, respectively, in diagnoses of inflammatory scrotal diseases and testicular torsion. Thus, our observations are comparable to previous studies. However, CDUS is not without pitfalls. Zoller and associates concluded that detection of intratesticular blood flow cannot exclude testicular torsion.⁽¹¹⁾

Derouet and coworkers observed ultrasonography to be 90% sensitive and 55% specific in detection of testicular neoplasms⁽¹²⁾ whereas Gallardo Agromayor and colleagues reported sensitivity of 100% for ultrasonography in diagnosing testicular neoplasm.⁽¹³⁾ In the present study, CDUS showed a sensitivity of 87.5% and specificity of 66.7% in detection of testicular neoplasms, which is compatible with the study carried out by Derouet and associates. In our series, 90% of seminomas appeared as solid, homogenous, hypoechoic, and hypervascular lesions compared to normal testicular tissue. In our study, all cases of varicocele were accurately diagnosed and also one patient, who presented with infertility and had no findings on clinical examination, was diagnosed with varicocele.

Other investigations like magnetic resonance imaging can be applied when ultrasonography proves inconclusive. Its use in scrotal diseases is increasing;⁽¹⁴⁻¹⁶⁾ however, it is more expensive and not always available. Nuclear scintigraphy, which has high sensitivity and specificity in differentiating ischemia from infarction, cannot accurately distinguish ischemia from conditions such as hydrocele, spermatocele, and inguinal hernia and is uncommon due to high accuracy

of CDUS.⁽⁵⁾ Therefore, CDUS with its high sensitivity and specificity is the most important investigation for diagnosis of scrotal diseases, presenting especially in emergency clinical setting.

CONCLUSION

We conclude that CDUS, which can simultaneously display scrotal anatomy and perfusion, is an excellent, a safe, and reliable method for evaluating patients with scrotal diseases, whether acute or chronic. It helps to improve patient's management, especially by preventing unnecessary surgical exploration. It is also convenient and easy to perform. But it has its own limitations, including difficulty in detecting intratesticular flow in small children and requiring adequate expertise and experience.⁽¹⁷⁾ Its results are also equipment dependent.

CONFLICT OF INTERST

None declared.

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